MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023

ECE3066 ARTIFICIAL INTELLIGENCE SYSTEMS AND APPLICATIONS

(LE, EE, CE, TE, NE)

10 JULY 2023
9:00 a.m. – 11:00 a.m.
(2 hours)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of 4 pages including cover page with 4 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided.

Question 1

(a) Briefly describe AI chatbot with example. [3 marks]

(b) Figure 1 shows the classical programming and general machine learning approach. Complete Figure 1 and briefly explain machine learning. [5 marks]

Figure 1 – Classical programming and general machine learning approach

(c) Identify THREE technical forces that accelerate the development of deep learning. [3 marks]

(d) Identify THREE types of deep learning networks and discuss their operations. [6 marks]

(e) Discuss the problems to be solved in retailers industry and how it can be improved by leveraging on artificial intelligence. [8 marks]

Question 2

(a) Discuss the stages in the workflow of developing a machine learning system. [12 marks]

(b) Below is the confusion matrix of a COVID-19 detection system, in which a positive case infers that the patient is infected.

		Actual	
		Infected	Normal
Predicted	Infected	105	11
	Normal	45	839

Analyse the confusion matrix to determine the following performance metrics:

(i) Total number of patients infected by COVID-19 [1 mark]
(ii) True positive [1 mark]
(iii) True negative [1 mark]
(iv) Type I error (false positive) [1 mark]
(v) Type II error (false negative) [1 mark]
(vi) Accuracy [2 marks]
(vii) Precision [2 marks]
(viii) Recall or Sensitivity [2 marks]
(ix) Specificity [2 marks]

Write your steps clearly.

Question 3

(a) Differentiate between classification and regression in supervised machine learning. [10 marks]

(b) A dataset consists of 10,000 data samples. Each sample shows two features (height and gender), and one target (weight) is available. In this dataset, the height is represented in centimeters (cm), the gender is represented using a binary number (0 for male and 1 for female), the weight is represented in kilograms (kg). The dataset has been used to train two linear regression models. Model 1 uses only a single feature (height) to estimate the weight. Model 2 uses two features (height and gender) to estimate the weight. Below are the equations for both the trained linear regression models:

Model 1: $\hat{w}_1 = 1.375h - 158.644$

Model 2: $\hat{w}_2 = 1.066h - 8.786g - 102.155$

where h is the height, g is the gender, $\hat{w}_1$ and $\hat{w}_2$ are the estimated weights for Model 1 and 2, respectively.

Both models are then evaluated using the test data as shown in Table Q3.

Table Q3: Test data for evaluation

Height	Gender	Weight
165.0	0	74.5
161.1	1	60.0
174.1	0	82.2

i. Calculate the estimated weights for the test data in Table Q3 using Model 1 and 2. Show all the workings involved. [6 marks]

ii. Calculate the mean square error (MSE) for Model 1 and 2 based on the test data in Table Q3. Show all the workings involved. [8 marks]

iii. Identify with justification which model has performed better based on the evaluation using the test data in Table Q3. [1 mark]

Question 4

(a) As a machine learning specialist, you are required to implement a fully connected neural network for a binary classification system with four input features. There should be two hidden layers with two neurons in each hidden layer. The hidden layers use SIGMOID activation function, while the output layer uses a RELU activation function.

i. Draw the neural network. [8 marks]

Continue ...

ii. Complete the Python code in Figure Q4(a) to build this neural network using Keras API. [6 marks]

```
model = ________
model.add(Dense(___, input_dim=___, activation='_____'))
model.___(Dense(___, activation='_____'))
_____.add(____(___, activation='_____'))
```

Figure Q4(a)

(b) If the input matrix is as shown in Figure Q4(b), determine the output of a 2 × 2 max pooling with a stride of 2 in both directions. [4 marks]

8	1	0	-2
-3	7	3	-5
1	-4	4	4
4	1	1	6

Figure Q4(b)

(c) Complete the Python code listing in Figure Q4(c) to implement a convolutional neural network (CNN) for a 4-class classification system using Keras API if the input grayscale images have the size of 128 × 128 pixels. There should be 40 filters with kernel size of 9 × 9 and zero padding in the CONV layer. Use average pooling with pool size of 2 × 2 and stride of 2 in both directions in the POOL layer. Use RELU activation function for the ACT layer and sigmoid activation function for the FC layer. [7 marks]

INPUT → CONV → ACT → POOL → FC

```
model = _________
model.add(Conv2D(__, (__,__), padding="same", input_shape=(___, ___,
1), activation='___'))
model.add(_____(pool_size=(_, _), strides=(_, _)))
model.add(____())
model.add(Dense(_, activation='______'))
```

Figure Q4(c) – Python code listing

End of Paper